ON A NEW MODEL OF THE EXHIBITION AS A STUDY OF EXHIBITORY METHOD IN THE AQUARIUM

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ON A NEW MODEL OF THE EXHIBITION AS A STUDY OF EXHIBITORY METHOD IN THE AQUARIUM[1)]

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In order to open a new field for the exhibition of living organisms in the aquarium, especially marine animals, one of the writers, Hirai, attempted to demonstrate the so-called "Micro-Aquarium" (Hirai, 1962, et al.). This is one method to generalize several kind of research materials of life cycles of marine invertebrates, especially ascidians, hydrozoans and echinoids, that have been studied in the Marine Biological Station of the Tôhoku University at Asamushi, and to show to the public the unpopularized life-phenomena of the microscopic aquatic animals, by using the monochromatic and color television systems. The

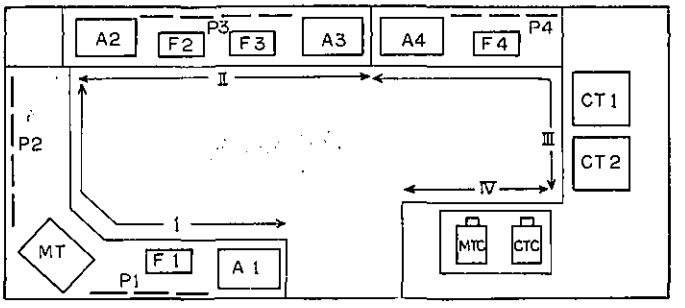

Fig. 1. Plane figure of the exhibition room.
I. Exhibition of *Glyptocidaris crenularis*.
II. Exhibition of *Halocynthia roretzi*.
III. Exhibition of *Cladonema uchidai*.
IV. Demonstration of the broadcasting systems of the television sets.
A. aquarium
CT. color telereceiver
CTC. color television camera
F. fixed specimen
MT. monochromatic telereceiver
MTC. monochromatic television camera
P. plate

1) Contributions from the Marine Biological Station of Asamushi, Aomori Ken, No. 334

writers found that this trial was completed, though there remained more room for improvement. It was the writer's conception to demonstrate not only an attractive stage of life-phenomena but also the whole life cycle, because the aquarium aims to make popular to the general public the wonders of aquatic life. After the so-called "Micro-Aquarium" was completed, the writers made a model for demonstrating the whole life cycle and this was opened to the public at the opening of the aquarium in 1965, though it was displayed on a small-scale (Fig. 1). Here, the writers report on this model.

Three kinds of animals were demonstrated at this time, namely, an ascidian *Halocynthia roretzi*, an echinoid *Glyptocidaris crenularis* and a hydrozoan *Cladonema uchidai*.

The writers wish to thank Dr. Makoto Toriumi of the Marine Biological Station of the Tôhoku University at Asamushi, for his valuable advices on the animals.

Exhibition of the life cycle of Glyptocidaris crenularis, Halocynthia roretzi and Cladonema uchidai.

I. Life cycle of *Glyptocidaris crenularis* (Fukushi, 1960).

The life cycle of the sea-urchin, *Glyptocidaris crenularis*, is displayed (Fig. 2).

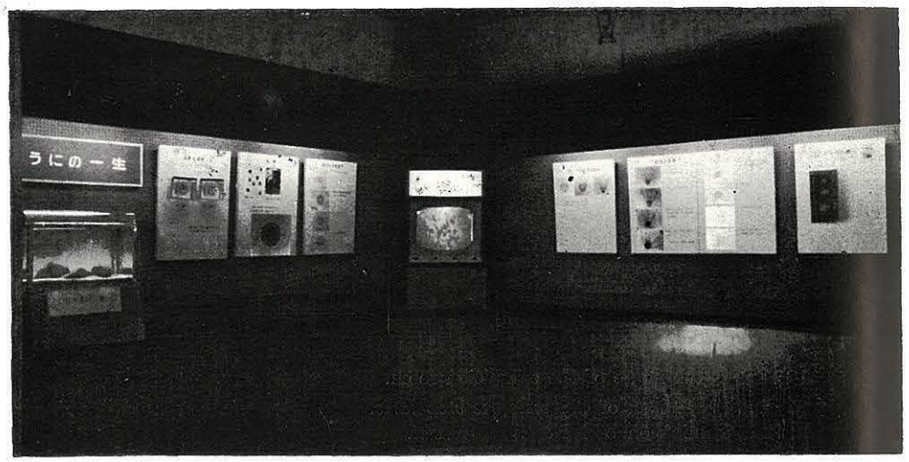

Fig. 2. Exhibition of the life cycle of *Glyptocidaris crenularis*. The adults are reared in the aquarium (left). The living pluteus larvae are shown by the monochromatic telereceiver (middle). The normal development of the egg and the metamorphosis are shown in serial photographs.

1. Adult.

Materials are reared in an aquarium (45cm×25cm×30cm) of the circulation system.

2. Male and female. (Exhibition of the anatomized fixed specimens.)
Explanations: "Male (testis). Female (ovary)." "When the test is opened, the testis or ovary is plainly seen attaching itself to the inside of the test."

3. Fertilized egg, about 0.1mm in diameter. (To compare the enlarged image of the egg with the fixed egg, a convex lens is attached to one side.)

4. The normal development of the egg, from fertilization through the cleavages to hatching, is shown in a series of photographs.
Explanations (partial omission): Fertilization: "Fertilized egg. Sperm spawned in sea water." "Egg just after fertilization. The fertilization membrane rises and quickly spreads arounds the egg." "After hatching the larva is seen swimming in the sea water."

5. The pluteus larva. (The living materials are shown by using the microscope and the monochromatic television, the size of which is 17 inches.)
Explanation: "By means of the movement of the cilia the larva swims actively in sea water. The larva is 0.2 mm in length."

6. The metamorphosis, from planktonic life to the just metamorphosed imago, is shown in a series of photographs.
Explanations (partial omission): "The larva changed from a spherical to triangular shape looking like a pyramid, the arms then grow out, increasing in length." "Arms become four pairs in number." "An echinus rudiment of *Glyptocidaris* is now seen as a blackish mass in the center of the pluteus, the dark area in the photographs." "The arms are very fragile and easily broken off." "The arms are nearly broken off except for a few bare arm skeletons. And before long, they begin to degenerate." "The young adult, just metamorphosed, about 50 days after fertilization, is 1 mm in diameter."

7. From the young to the mature adult. (Exhibition of three different sizes of the fixed tests, 1.5cm, 2.5cm and 4.0cm in diameter, respectively.)

II. Life cycle of *Halocynthia roretzi* (Hirai, 1941, et al.).

The life cycle of an ascidian, *Halocynthia roretzi*, is displayed in this corner (Fig. 3 and 4).

1. Adult.

The adults of about four years in age are reared in an aquarium of the circulation system.

2. Male and female. (Exhibition of the anatomized fixed specimen and a chart.)
Explanation: "*Halocynthia roretzi* is hermaphroditic, therefore it has both testis and ovary in the body and the sexes are not separate."

3. Fertilized egg, about 0.3mm in diameter. (Exhibition of the fixed egg itself and the enlarged image of it by employing a convex lens.)

4. The normal development of the egg, from the fertilized egg through the cleavages to the completion of metamorphosis, is shown in a series of photographs.
Explanations (partial omission): "The fertilized egg is enveloped by transparent,

Fig. 3. Exhibition of the life cycle of *Halocynthia roretzi*. About four years old adults and young adults of two or three years age are reared in the aquaria respectively (left and right). Two boxes on the table are for the exhibition of the fixed egg and the tadpole larva, and to compare the enlarged image and the material itself, a convex lens is attached to one side of the box.

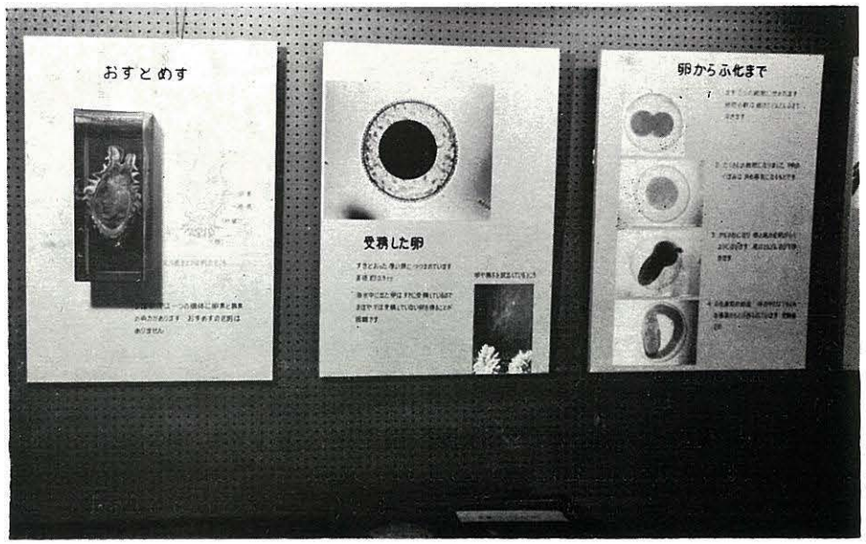

Fig. 4. The anatomized fixed adult of *Halocynthia roretzi* is displayed as the exhibition of "male and female" (left). The photographs show the fertilized egg and the normal development, from the two-cells stage to just before hatching (middle and right).

thick envelopes". "At first, the egg is divided into two equal halves." "The egg divided into too many cells to be counted." "The embryo changes from bowl-shape to gourd-shape, and the tail can be distinguished from the body. The tail becomes elongate with time." "The embryo, just before hatching". "Tadpole larva, about 1.5mm in total length: it has recognized externally that a notochord passes through the tail, but it is absorped and disappeared during metamorphosis when the larva grows to become an adult."

5. Tadpole larva. (Exhibition of the fixed tadpole larva and its enlarged image.)

6. The metamorphosis is shown in a series of photographs.

Explanations (partial omission): "When the settled tadpole attaches to the substratums in the sea water, it undergoes rapid degenerative metamorphosis. At first, the tail is absorpted." "When the absorption is completed, the body become spherical and the chin region grows enormously."

7. The young adult.

The young adults of two or three years age are reared in an aquarium of the circulation system.

III. Life cycle of *Cladonema uchidai* (Hirai and Kakinuma, 1957, et al.).

One example of the life cycle of an athecate hydroid, *Cladonema uchidai* is displayed in this corner (Fig. 5 and 6).

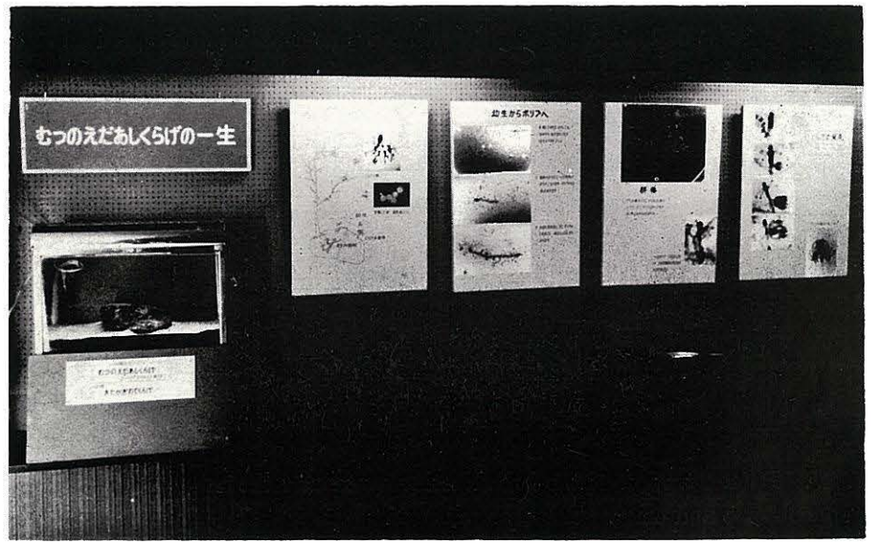

Fig. 5. Exhibition of the life cycle of *Cladonema uchidai*. The medusae and colonies are kept alive in the aquarium (left).

Fig. 6. A color telereceiver shows the hydranth and the medusoid bud of *Cladonema uchidai*. Two telereceivers are switched over from the forenoon to the afternoon in every day.

1. Medusa.

The medusae and colonies with hydranths are kept alive in an aquarium of the circulation system.

2. The life cycle of this species is shown in a series of photographs. Explanations (partial omission): "Adult medusa". "Fertilized egg, about 0.1 mm in diameter." "From the swimming planula to hydroid stage: After the attachment of the planula, a hydrorhiza is formed as a long stolon from the base of the hydranth." "Colony: Some hydranths are formed on the stolons spreading like a cobweb." "A hydranth." "Bud of medusa". "Young medusa, just liberated from the hydranth."

3. Colony is shown as the fixed specimen.

4. Hydranth and medusoid bud.

This is demonstrated by using a binocular microscope and the color television of a microscopic camera and a color telereceiver which is 21 inches in size.

IV. Demonstration of the broadcasting system of the microscopic television in monochrome and color. They are arranged together on the same table in order to be exposed to the public through a glass window. Thus, the visitors can see the video and its broadcasting system at the same time (Fig. 6 and 7).

The above mentioned demonstrations are the initial condition of the opening of

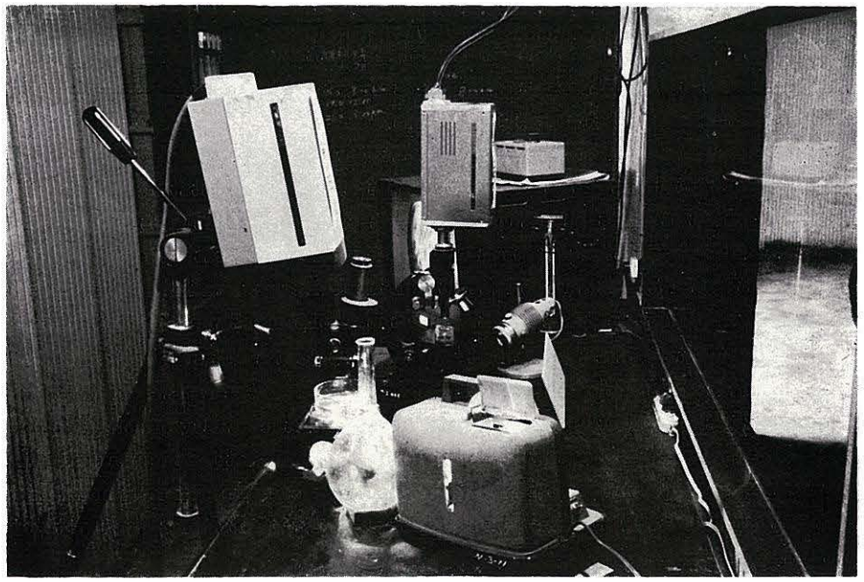

Fig. 7. The apparatus in the broadcasting room, showing a color television camera (left) and a monochromatic television camera (right) attached on a microscope respectively, and a monitor. This room is visible from the demonstrating room through the glass window (right).

the aquarium in 1965. Besides *Glyptocidaris*, three other sea-urchins, *Hemicentrotus pulcherrimus*, *Temnopleurus hardwickii* and *Strongylocentrotus nudus* are available for display during their respective breeding season. The larvae of the sea-urchins are always kept alive in an ice box in our laboratory. The adults of *Halocynthia roretzi* are kept alive for about four months in an aquarium, so they can be renewed twice in the year. For the demonstration of the life cycles of the medusa, *Aurelia aurita*, *Gonionemus oshoro* and others are prepared.

At present, about ten species of hydrozoans and scyphozoans are being continually cultured in the cabinet-system (Hirai and Itô, 1962). The cultivations for several biological investigations have been done in our laboratory, and in consequence, the colonies and medusae of three species, namely, *Cladonema uchidai*, *Aurelia aurita* and *Gonionemus oshoro*, are available for the demonstration at any time.

The so-called "cabinet-system" is a simple cabinet, 120cm×80cm×80cm. The cabinet is ceiled with boards and the sides with curtains and vinyl sheets. At one side of the cabinet it is connected with a cooler during summer and a heater during winter (with a thermoregulator). Therefore, favorable temperatures for the respective animals can be conditioned by this system.

CONSIDERATION

Tokioka (1962), Seto Marine Biological Laboratory of the Kyoto University, sorted the present aquaria registered in this country as follows:

1) Aquarium for pure scientific purpose.
2) Aquarium for educational and recreational purpose.

He says that the aquaria belonging to the biological stations of several national universities must be placed under the category of the first section. The Asamushi Aquarium, belonging to the Marine Biological Station of the Tôhoku University at Asamushi, is an open facility of the university, and also belongs to the first category. Therefore, the exhibitions to the public must aim at scientific educations. Thous, in this case the majority of the visitors are not specialists in biology and have inadequate biological knowledge. So, though the aquarium belongs to the university, the exhibitions need not be of equal to the gallery of scientific specimens. If the aquarium is open to the public, it is necessary to make the exhibitions attractive, beautiful and accessible, and also very easy to understand. If the displays are difficult for the general public to understand, it is not worthy to open the aquarium.

From this point of view, the writers made efforts for the demonstration of the above-mentioned model (Itô had charge of this work). For instance, the exhibition of the scientific photographs, would not be accesible to the public unless put on display by persons in such a position, as the writers. Particular attention should be given to the fact that the visitors are more fascinated by moving specimens, viz. fihes, than by complex photographs and reading troublesome explanations in the aquarium. So, in order to facilitate the understanding of the public the series of embryologic photographs supplemented by, the living materials were displayed in the aquaria with circulation systems and at the same time the fixed specimens of the eggs and larvae were also displayed so that the observers can confirm the shapes and sizes of the originals shown in the photographs.

The writers made sincere efforts in the demonstration of the developmental stage of the life cycle, and displayed natural beauties of forms and colors and biological importances by using the monochromatic and color television systems, which was so-called "Micro-Aquarium". Moreover, electronic music was played in association with the sea water, and this produced a mild and enthusiastic atmosphere in the exhibition room. Because of the imperfection of good apparatus such as for an endless-tapecorder, however, music was played only on the day of many visitors.

The writers observed that the above-mentioned exhibition is really magnetic. But it has more room for improvement. In the present case of photographs, for instance, scientific ones showing development in succession were used in the exhibitions. This is of much use for specialists but less for the general public.

Because the photographs are pure scientific demonstrations and thus too difficult for the public to understand the natural field. Here, it is to be mentioned that a model appeared concerning the animal photographs taken by Tokumitsu Iwagô. His subject is "the animal photographs including their life-environment", that is to say, "the natural beauties of animals must be harmonized with their respective environments (Iwagô, 1963)." The writers wish to adopt his view concerning the photographs, and have tried take them over again. But actually it is very difficult yet an important problem to find the differences between the presentation of special scientific results and the exhibitions to be made in opening the aquarium to the general public.

The aquarium must be opened with correct exhibitions every day, so, there is an urgent necessity for easily keeping the materials alive for the demonstration and the demonstrating sets. In this respect, the exhibition of the life cycles of the marine invertebrates is a very hard task, but now the model is stable in outline although of small scale, that is to say, the materials are continually cultivated in a cabinet-system on the basis of years reseaches' results in our laboratory.

This cabinet-system is not expensive, of small-size and can be set in a corner of a room. The glass aquaria with circulation systems are kept in the cabinet in which the materials of various species are reared. There is no necessity for keeping the strict temperature at the inner parts of the cabinet. It troughly ranges from 10° C to 20°C. To-day, about ten species of hydrozoans and scyphozoans are cultivated in stability.

Our aquarium has two sets of television now, namely, one monochromatic television camera and telereceiver and one color television camera and two color telereceivers. The two color telereceivers are switched over from the forenoon to the afternoon.

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